Contribution to taxonomy of age 0 *Notropis heterodon* (Cope) and *Notropis heterolepis* (Eigenmann & Eigenmann)

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ABSTRACT

Leslie, J.K., and C.A. Timmins. 2000. Contribution to taxonomy of age 0 *Notropis heterodon* (Cope) and *Notropis heterolepis* (Eigenmann & Eigenmann). Can. Tech. Rep. Fish. Aquat. Sci. 2321.

Age 0 blackchin shiner *Notropis heterodon* (Cope) and blacknose shiner *Notropis heterolepis* (Eigenmann & Eigenmann) were collected in vegetated areas at the shore of Lake Huron and Lake Erie. Morphology, morphometry, meristics, pigmentation and illustrations of preserved fish (5-26 mm) are presented as identification aids. Early developmental stages of blackchin shiners and blacknose shiners are not separable taxonomically. Later stages (>12 mm) are separable on the basis of shape of snout and mouth, and pigmentation. Both species have 21-23 preanal and 13-14 postanal myomeres, 35-37 vertebrae, preanal length 51-61% TL, and a head and body-length black lateral stripe.

RÉSUMÉ

Leslie, J.K., and C.A. Timmins. 2000. Contribution to taxonomy of age 0 *Notropis heterodon* (Cope) and *Notropis heterolepis* (Eigenmann & Eigenmann). Can. Tech. Rep. Fish. Aquat. Sci. 2321.

Des spécimens de menton noir (*Notropis heterodon* [Cope]) et de museau noir (*Notropis heterolepis* [Eigenmann et Eigenmann]) d'âge 0 ont été capturés dans des herbiers près de la rive des lacs Huron et Érié, en Ontario. Ce rapport présente la description et des illustrations de spécimens conservés (de 5 à 26 mm de longueur). Des données sur leur morphologie, leur morphométrie, leurs caractéristiques méristiques et leur pigmentation sont présentées pour aider à identifier ces espèces. À leurs premiers stades de développement, les mentons noirs et les museaux noirs ne peuvent être distingués. À des stades subséquents (longueur >12-14 mm), les deux espèces se différencient par la forme du museau et de la bouche ainsi que par la pigmentation. Elles possèdent toutes les deux de 21 à 23 myomères pré-anaux et 13 ou 14 myomères post-anaux, de 35 à 37 vertèbres ainsi qu'une bande latérale foncée le long du corps et de la tête; leur longueur du museau à l'anus représente de 51 à 61 % de la longueur totale.

INTRODUCTION

Taxonomic descriptions of age 0 fishes of the Great Lakes basin have been rare since Auer (1982) published her manual on the identification of larvae. Although many specimens of field-collected fishes are held in research laboratories, the majority is either underdescribed or undescribed. Among such fishes are the blackchin shiner *Notropis heterodon* (Cope) and blacknose shiner *Notropis heterolepis* (Eigenmann & Eigenmann), two of 34 native cyprinids in Ontario.

In Ontario, the blackchin shiner is a member of the littoral fish taxocene in many locales south of 50°N (Keast and Eadie 1984; Leslie and Timmins 1995; 1997a,b; 1999; Mandrak and Crossman 1992). Early in the twentieth century, Bensley (1915) observed this fish "in the millions" in swampy areas of eastern Georgian Bay, Lake Huron. Elsewhere in Canada, the blackchin shiner occurs in southern Manitoba and western Quebec (Houston 1996) in clear water where submersed macrophytes prevail in creeks, rivers, and bays.

The blacknose shiner is distributed mainly south of 55°N, from Nova Scotia to Saskatchewan. In Ontario, its range is much wider than that of the blackchin shiner, although it is not as abundant. This fish inhabits sparsely vegetated, sandy shore areas, muddy bottoms of small lakes (Scott and Crossman 1973), and lakeshore lagoons (Mahon and Balon 1977).

Herein, we describe and illustrate early developmental stages of these cyprinids, which were collected during the past 15 yr in southern Ontario.

Study area

Blackchin shiner

Age 0 blackchin shiners described in this study were collected in Hog Bay, a 318-ha shallow, eutrophic embayment on the south shore of Severn Sound, Lake Huron. Hog Bay (44°45'N, 79°47'W) has balanced fish and macrophyte communities, and the fish taxocene consists of at least 31 species, dominated by pumpkinseed *Lepomis gibbosus*, yellow perch *Perca flavescens*, alewife *Alosa pseudoharengus*, golden shiner *Notemigonus crysoleucas*, and blackchin shiner (Leslie and Timmins 1995). Bushy pondweed *Najas flexilis*, curly pondweed *Potamogeton crispus*, waterweed *Anacharis canadensis*, wild celery *Vallisneria americana*,

coontail *Ceratophyllum demersum*, and water milfoil *Myriophyllum spicatum* are common submersed species. Emergent vascular plants are dominated by pickerelweed *Pontederia cordata*, spike rush *Eleocharis* sp., giant bur-reed *Sparganium eurycarpum*, bulrush *Scirpus* sp., and broad-leaved cattail *Typha latifolia*. This macrophyte community appears to be favoured by blackchin shiners for reproduction and as nursery habitat (Trautman 1981).

Blacknose shiner

Blacknose shiners were collected from late spring to early autumn in eutrophic Long Point inner bay (42°37'N, 80°10'W), which has a catchment of 947 km^2, a surface area of about 68 km^2, and a mean depth of 1 m. Almost the entire bottom of the inner bay is vegetated in summer. Dominant vascular aquatic plants include wild celery, stonewort *Chara vulgaris*, pondweeds, water milfoil, cattail *Typha* spp., and rush *Eleocharis elliptica* (Bailey 1988). Thirty-three fish species were collected in a brief fish larvae survey in 1985 (Leslie and Timmins 1995). The age 0 fish community at the shore was dominated by pumpkinseed, brook silverside *Labidesthes sicculus*, blacknose shiner, and brown bullhead *Ameiurus nebulosus*.

Effects of wind in protected shore areas are minimal because of physical damping of waves by macrophytes, and by the east-west (prevailing wind) orientation of the inner bay. The substrate consists mostly of sand, with alluvium deposits at the mouth of Big Creek, at the western extremity of the bay. Abundant rooted plants provide associated food items for fish and shelter from predators. The blacknose shiner was numerically dominant in Long Pond, a lagoon on Long Point (Mahon and Balon 1977), and one of the most common shore species in the inner bay (Leslie and Timmins 1995).

MATERIALS & METHODS

Fish sampling took place in 1991, 1992, and 1999. Equipment and techniques used to collect age 0 fishes were the same in all years and locales. A bulging larval fish beach seine (4-m long, 1-m wide, 0.3-mm mesh opening) was hauled 10 to 15 m at the offshore margin of submersed and floating plants. Sampling took place during the day at depths of 0.2 to 1.0 m. Collected fish were immediately fixed with 5-10% formalin and sorted within 3 mo. Specimens were transferred to a 12:1 mixture of 70-80% ethanol and glycerol. Because no larvae <5 mm were found, few free embryos, or just-hatched fish, are included in descriptions.

Linear measurements of body parts <5 mm were accurate to ±0.02 mm, and to ±0.2 mm for body parts >5 mm. Morphometrics were determined with an ocular micrometer on a dissecting microscope. Representative fish were cleared using the technique of Pothoff (1984). Successively smaller larvae were identified regressively according to meristic and pigmentary patterns of larger age 0 fish. Methods and terms describing morphologic characteristics follow those of Berry and Richards (1973) and Auer (1982). Voucher fish are maintained at Great Lakes Laboratory for Fisheries and Aquatic Sciences, Burlington, Ontario.

DESCRIPTIONS

Class **Actinopterygii**
Order **Cypriniformes**
Family **Cyprinidae**

Notropis heterodon (Cope)

Because detailed information on reproductive activities of the blackchin shiner has not been published, preferred spawning temperatures of this fish are unknown. However, they may be inferred from collections of early developmental stages. In Hog Bay, first occurrence of small (5 mm) larvae in July and early August suggests that spawning may occur slightly later than for many fishes. Keast and Eadie (1984) provide growth data on blackchin shiners in Lake Opinicon, Ontario, where first spawning takes place when fish are 1-2 years-old and the spawning period, mid-June to late July, has a duration of 38 d.

Morphology, meristics, and morphometry

The blackchin shiner has 22-23 preanal, 13-14 postanal, 35-36 total myomeres, and 36-37 vertebrae. At 6 mm TL, larvae have a small open mouth; the fin fold originates at about the tenth myomere and is continuous to mid-gut. The snout is blunt, and the oval eyes protrude. The single swim bladder is inflated. The urostyle is flexed at 7-8 mm (Fig. 1); the trunk is slender, the intestine long and straight, and hypurals are developing. Ventral rays are present in the caudal fin. At 8 mm, two swim bladders are inflated and the dorsal fin fold originates at about the twelfth myomere. Dorsal, anal, and caudal fins attain the full complement of principal rays at 9-10 mm. Appearance of the pelvic fin bud, and development of a homocercal caudal fin also occur at 9-10 mm (Fig. 1). The pectoral fin develops first rays when larvae are approximately 10-11 mm. Gill

membranes are joined at the isthmus. Premaxillaries are clearly protractile when larvae are about 13 mm TL.

At 14 mm, the fin fold has completely degenerated and pelvic fins possess the full complement of principal rays. First scalation develops on the dorso-lateral area of the caudal peduncle and dorso-lateral body surface at 16-17 mm. The origin of the pelvic fins is clearly in advance of the dorsal fin origin (Fig. 2), and the intestine develops a single loop. At 20 mm, fish have at least two rows of dorso-lateral scales between cleithrum and caudal fin base; scales also cover the ventro-lateral surface of the peduncle. Mid-dorsally, an irregular row of 14-15 scales is present between head and dorsal fin origin. The snout is more pointed as fish grow and the jaws articulate below the nares. The tip of the upper jaw and centre of the orbit are in line (Fig. 2). Pectoral and dorsal fins are pointed. Depressed pelvic fins almost reach the anus. Age 0 fish closely resemble adults in morphology and pigmentation at about 20-24 mm (Fig. 3).

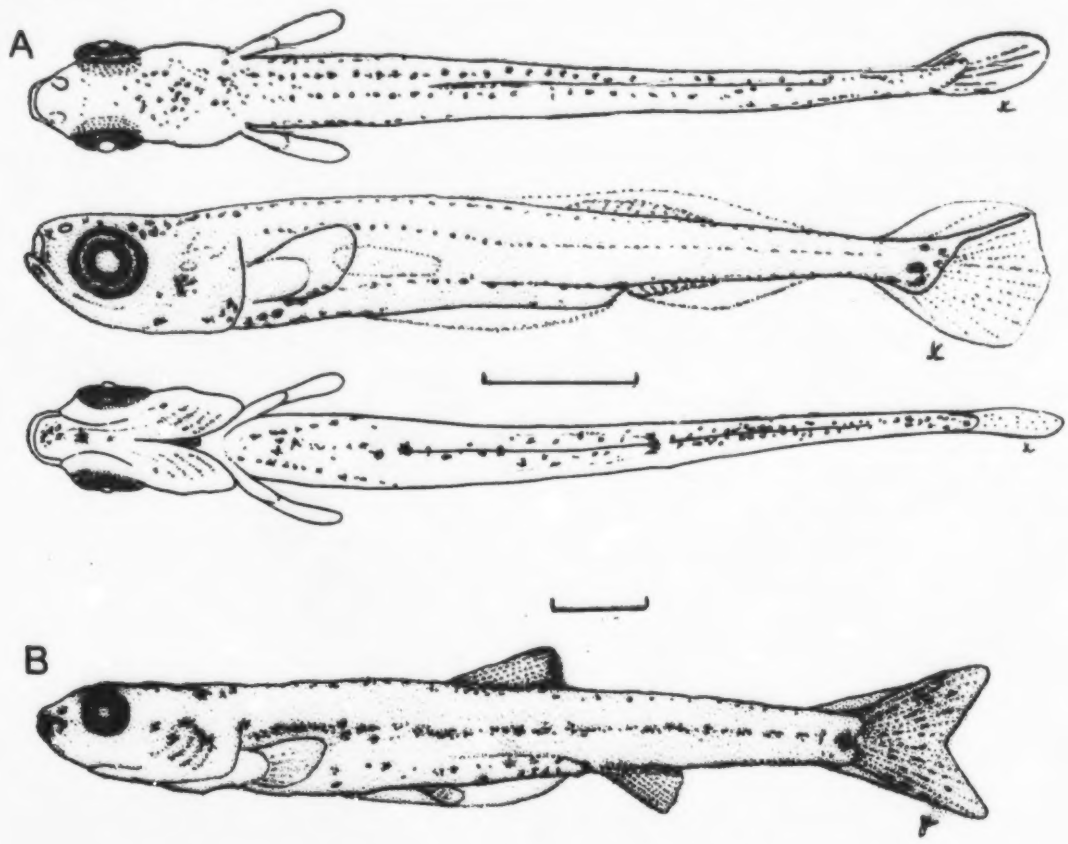

Fig. 1. A: dorsal (upper), lateral (middle), and ventral (lower) aspect of *Notropis heterodon* at 7.0 mm. B: lateral view of a 10.6-mm fish. Length bars = 2 mm.

Morphometrics and meristics for the blackchin shiner are given in Table 1. Small fish exhibit characteristics common to most cyprinids during early development: a slender form dominated by a relatively large head and eyes, and anus situated at about 60% TL. Eye diameter decreased from 38% head length (HL) at 6-10 mm to 32-34% at 20-26 mm TL. Snout length increased from 18% HL at 10 mm to 24% HL at 20 mm. With growth, the body became increasingly terete, while head length remained constant relative to total length. In all size classes, prepelvic length was static at about 40% TL whereas body depth increased (Table 1). At about 20 mm, pelvic fin length was at least 90% pectoral fin length. As fish grow, the position and form of mouth and jaws, and pigmentation increase in importance as identification aids.

Table 1. Morphometry and meristics for age 0 *Notropis heterodon*. Lengths expressed as mean percentage of total length TL ± SD (mm) for each size class. SL = standard length; PA = Preanal; Hd = Head; PD = Predorsal; Ped = Peduncle; N = number of specimens measured. N/A = not applicable. Myomere values modal; range in parentheses.

Size class	5.1-8.0	8.1-11.0	11.1-14.0	14.1-17.0	17.1-20.0	20.1-24.0	24.1-26.0
N	26	31	11	21	11	18	4
TL	6.9 0.7	9.4 0.9	12.5 0.7	15.7 0.8	18.7 1.0	21.4 0.7	24.7 0.4
SL	94	88	86	84	83	82	81
PA	61	60	56	55	53	53	51
Hd	20	22	23	22	22	21	21
Eye	8	8	7	8	8	8	8
PD	45	44	44	43	42	42	41
Ped	4	5	6	6	7	7	7
> Depth	10	12	14	14	15	17	17
Myomeres							
Preanal	23 (21-24)	23 (22-24)	23 (21-24)	22 (22-23)	22 (21-22)	22 (21-23)	22 (21-22)
Postanal	13 (12-14)	13 (12-14)	13 (13-14)	13 (13-14)	14 (13-15)	13 (13-15)	13 (14-15)
Total	36 (34-37)	35 (35-37)	36 (34-37)	36 (35-36)	35 (34-36)	35 (34-36)	35 (35-36)
Fin rays							
Dorsal	0-6	6 (6-9)	8	8	8	8	8
Anal	0-3	6 (2-8)	8 (4-8)	8	8 (7-8)	8 (8-9)	8 (7-8)
Pelvic	N/A	1 (0-6)	8 (4-8)	8	8 (7-9)	8	8
Pectoral	N/A	2 (0-8)	11 (4-13)	11 (11-13)	11 (9-13)	13 (13-14)	14 (13-15)
Caudal	3-19	18-19	19	19	19	19	19

Pigmentation

At least one large stellate melanophore is situated on each side of the upper jaw, and one on the ventral margin of the lower jaw of 6-mm fish. Light-brown melanophores are situated on dorsal and ventral margins of the urostyle. At 7.0 mm, a group of spots form a triangular patch on top of the head. Paired round spots extend from the nape to the dorsal fin insertion. Dorsal pigmentation is diffuse in the posterior half of the body, and a single line of small stellate melanophores is evident on the peduncle. A dark, sub-surface "dash" is evident on the isthmus. Several spots on the postorbital area constitute initiation of the lateral body stripe (Fig. 1).

A series of spots and dashes, one per myomere, exists on the horizontal myoseptum. The margin of the chin has light-brown pigment, and 3 or 4 large stellate melanophores are located near the lower jaw. A series of spots on each side of the anal fin coalesce at its insertion and continue to the base of the caudal fin. An epaxial series originating at the base of the pectoral fins joins a series on the dorsum of the intestine. A dark spot behind the anus and a vertical series of 3 large blotches prevail on the hypurals.

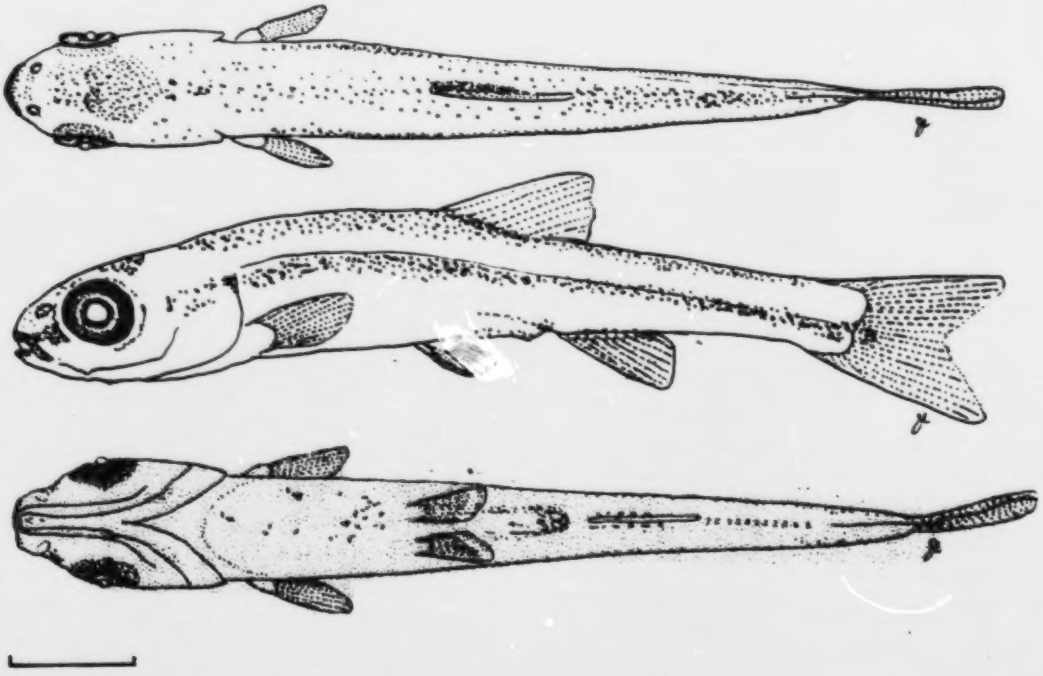

Fig. 2. Dorsal (upper), lateral, and ventral aspect of *Notropis heterodon* at 16.0 mm TL. Length bar = 2 mm.

At 8-9 mm, the mid-lateral series originates at the second myomere and continues to the caudal fin base, where it expands. At 12-14 mm, dark brown pigment covers the premaxillaries, side of snout, and chin. The lateral body stripe from pectoral fin to above the anal fin continues just below the horizontal myoseptum, then proceeds along it. The pectoral fin is darkly pigmented on the dorsal margin of the first two rays. Whereas the pelvic fin is barren, the first two rays of the anal fin are pigmented, as are all dorsal and caudal fin rays. The epaxial series on the gut has disappeared. At 16 mm, gross dorsal and ventral pigmentation take the form depicted in Fig. 2.

At 20 mm, the body-length stripe is serried, and at 24 mm, the anterior portion lies almost completely below the myoseptum; posteriorly, the stripe straddles the myosteptum. Faint spots on the hypurals and caudal fin base are scarcely joined. The peritoneum is unpigmented. At 24-26 mm, fish are ventrally barren from head to pelvic fins. Posteriorly, darkest ventral pigmentation occurs around the margin of the anus and base of the anal fin (Fig. 3). Dark heart-shaped pigment covers the occiput. A thin, faint mid-dorsal line may be present on some fish. The posterior portion of the dorsal fin base is dark-brown.

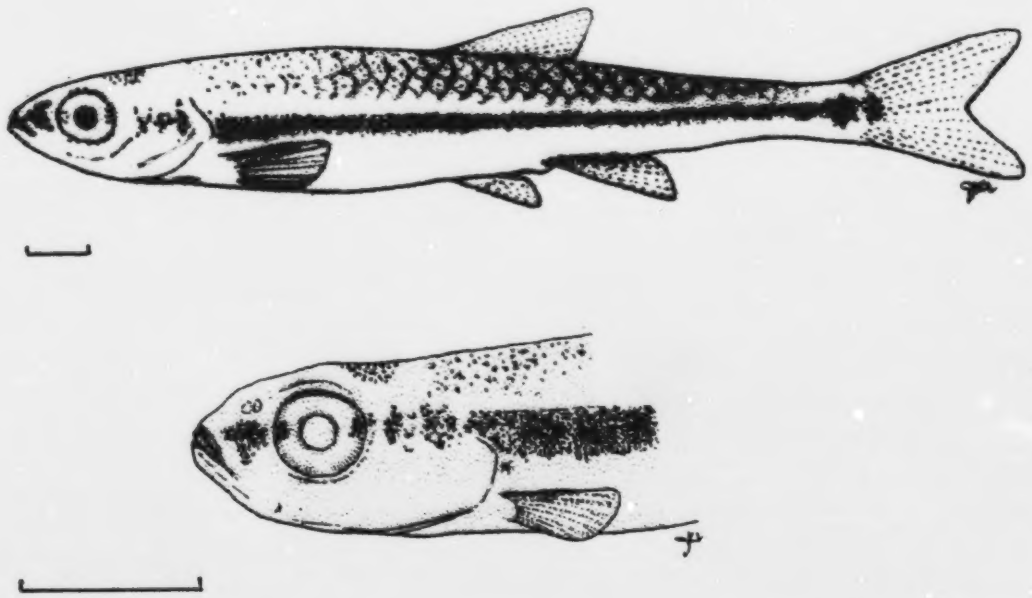

Fig. 3. Lateral aspect and head of *Notropis heterodon* (24 mm TL) collected in Hog Bay, Severn Sound. Length bars = 2 mm.

Notropis heterolepis Eigenmann & Eigenmann

Little information on blacknose shiner reproduction is available, and only one age 0 developmental stage, a 20-mm fish, has been described and illustrated (Fish 1932). Collections at the shore in Long Point inner bay (Leslie and Timmins 1997b) and anecdotal information indicate habitat type and approximate spawning temperatures. Small larvae first appear in mid-June at water temperatures of 20-23° C. Thus, spawning in the inner bay may begin in early June. In New York and Ohio, spawning has been reported in mid or late July (Fish 1932; Scott and Crossman 1973; Trautman 1981). Ovarian eggs removed from two specimens (56 and 53 mm TL) in Long Point inner bay were spherical and dark-yellow in colour. Mean diameter of eggs in respective fish was 0.7 mm (range = 0.5-0.9 mm; N = 107) and 0.6 mm (range = 0.5-0.7 mm; N = 118).

Morphology, meristics, and morphometry

At 5-6 mm, blacknose shiners have a short, blunt snout and open mouth. A trace of yolk in the sac may or may not be present. Oval, protruding eyes dominate the head. The body is slender, with small, fan-shaped pectoral fins. At 6-7 mm, the single swim bladder is inflated and the median fin fold, which originates at the eighth myomere, is continuous to mid-gut. The anus is situated in the posterior half of the body, and the urostyle flexed (Fig. 4). There are 4 incipient ventral rays in the caudal fin. At 8 mm, anal and dorsal fin anlages are first observed, and at 9 mm, all principal rays are developed in the caudal fin. Two swim bladders are inflated.

Dorsal and anal fins attain full complement of rays at 9-11 mm, when first rays develop in the pectoral fin (Fig. 4). The pelvic fin bud is first observed at 9-12 mm and rays appear at approximately 10-12 mm. All pelvic rays are developed when larvae are ~14 mm TL, and principal rays are present in all fins at approximately 16 mm, or just before disappearance of the fin fold between anus and pelvic fin base (Fig. 5). Jaws articulate below the anterior margin of nares, and the mouth is subterminal at about 15 mm TL. With growth, pectoral fins are increasingly pointed. These features may be observed in Fish's (1932) illustration of a 20-mm specimen (Fig. 6).

Blacknose shiner larvae have 21-23 preanal, 14 postanal, 35-36 total myomeres, and 36-37 vertebrae. In smallest fish, eyes are large relative to head length (40% HL). Snout length

increased from 10% HL at 5-8 mm to 20% at 12-17 mm. Pelvic fins are about 85% pectoral fin length, which is 11% TL. Scalation on 17-20 mm fish first appears on the dorso-lateral aspect of the peduncle. Age 0 juveniles have 14-15 predorsal scales situated irregularly on the dorsal ridge. Table 2 presents meristic and morphometric data for 110 age 0 blacknose shiners in 5 size classes.

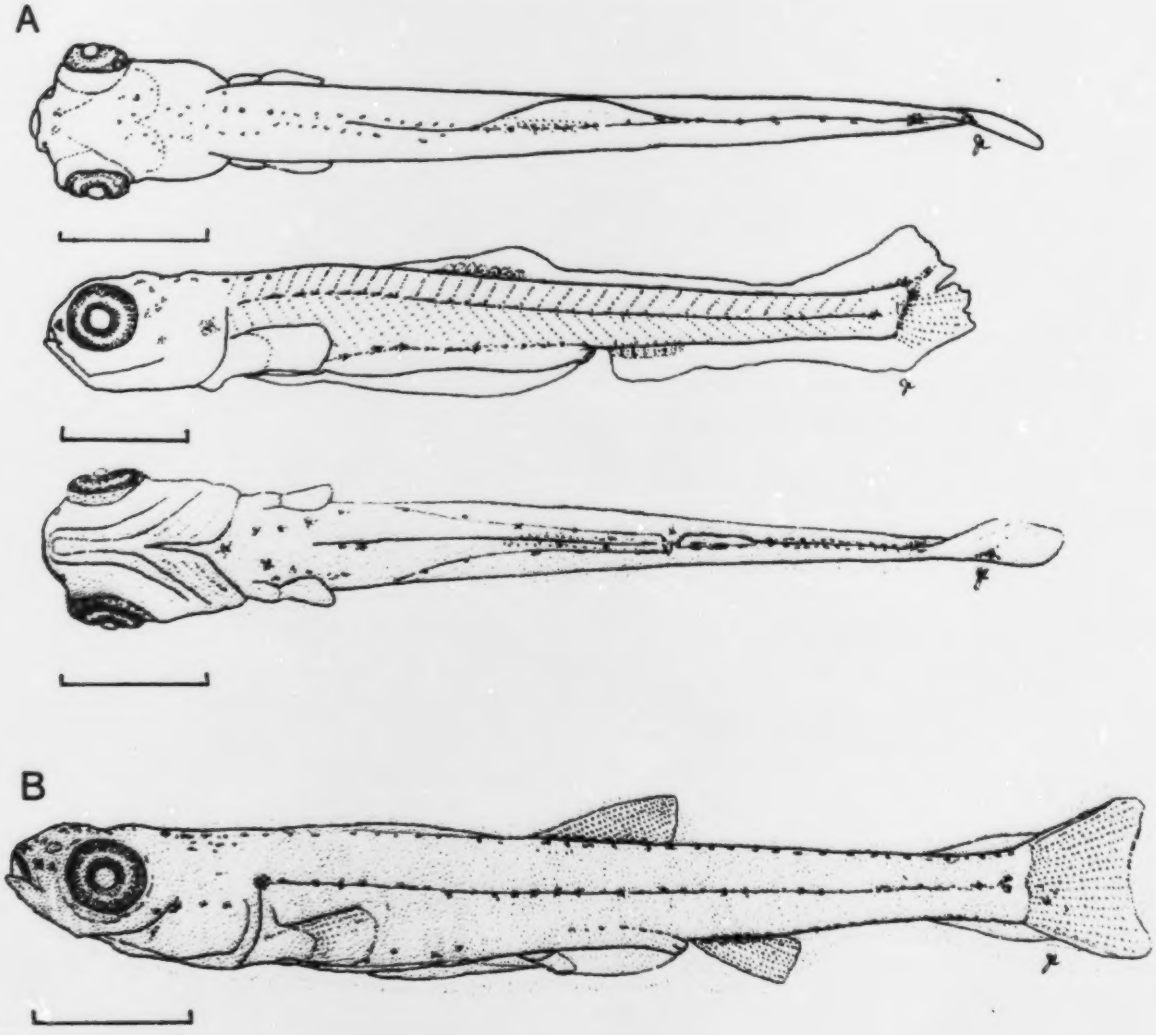

Fig. 4. A: dorsal (upper), lateral, and ventral (lower) aspects of 7-mm fish; B: lateral aspect of 10.6-mm *Notropis heterolepis*, collected in Long Point inner bay, Lake Erie. Length bars = 2 mm.

Table 2. Morphometry and meristics for age 0 *Notropis heterolepis*. Lengths expressed as mean percent TL ± SD (mm) for each size class. Myomere values modal; range in parentheses. Designation for length characters as in Table 1. N/A = not applicable.

Size class	5.1-8.0	8.1-11.0	11.1-14.0	14.1-17.0	17.1-24.0
N	18	33	33	17	9
TL	6.3 0.8	9.2 0.8	12.7 1.1	15.4 0.9	21.9 3.5
SL	95	92	85	84	80
PA	59	59	56	54	52
Hd	18	21	22	22	21
Eye	7	7	7	7	7
PD		48	45	44	42
Ped	4	5	6	7	7
>Depth	11	12	13	14	16
Myomeres					
Preanal	23 (21-23)	22 (21-23)	21 (20-23)	21 (19-22)	20 (19-21)
Postanal	14 (12-14)	14 (13-14)	14 (13-15)	14 (13-15)	14 (14-15)
Total	36 (34-37)	35 (34-36)	35 (33-37)	35 (33-37)	34 (33-35)
Fin rays					
Dorsal	0-5	0-8	8	8	8
Anal	0-3	0-8	0-8	8	8
Pelvic		0-6	4-8	7-8	8
Pectoral		0-12	4-13	11-14	12-14
Caudal	3-10	18-20	18-19	18-20	19-20

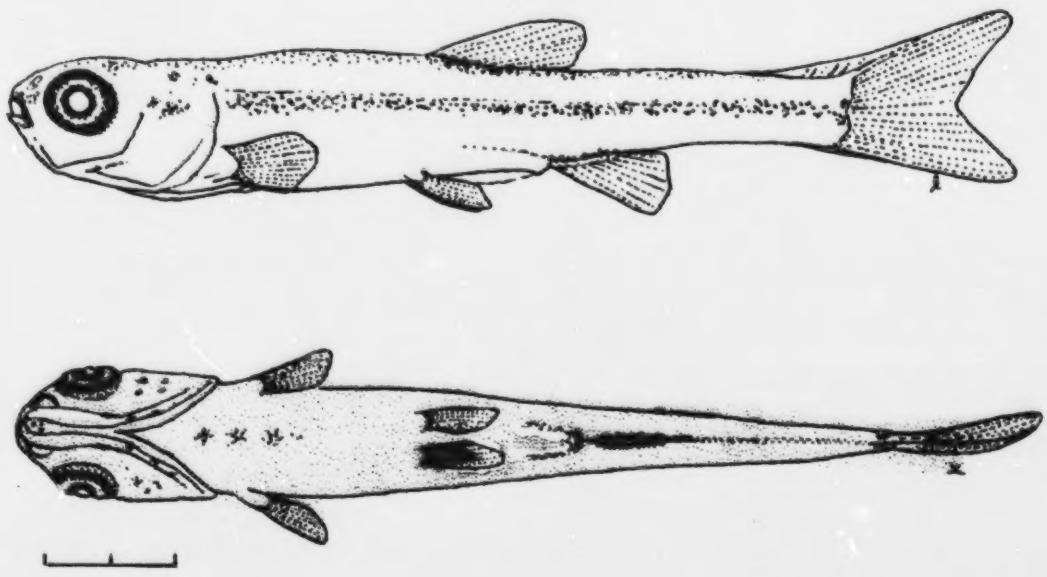

Fig. 5. Lateral (upper) and ventral (lower) aspect of *Notropis heterolepis* at 16.0 mm. Length bar = 2 mm.

Pigmentation

Pigment is faint on head and body surfaces of 5-7 mm fish. At least one large stellate melanophore is located on each side of the snout. The eyes are dark brown. About 5 stellates are grouped on the postorbital surface. A body-length, mid-lateral line of minute spots, usually one on each myomere, extends from the third or fourth myomere to the caudal base (Fig. 4). On the dorsum, paired melanophores are present from nape to mid-body, where an irregular series of round melanophores continues to the peduncle. Ventrally, a series of melanophores occurs on each side of the gut, with several faint stellates scattered over the surface (Fig. 4). The gut series follows the dorsal surface of the intestine and terminates at the anus. The dorsal surface of swim bladders is lightly pigmented at 9 mm. On 10-11 mm fish, dark brown pigment prevails on each side of the anal fin (Fig. 4). Two adjacent lines of pigment extend from anal fin insertion to the caudal fin base.

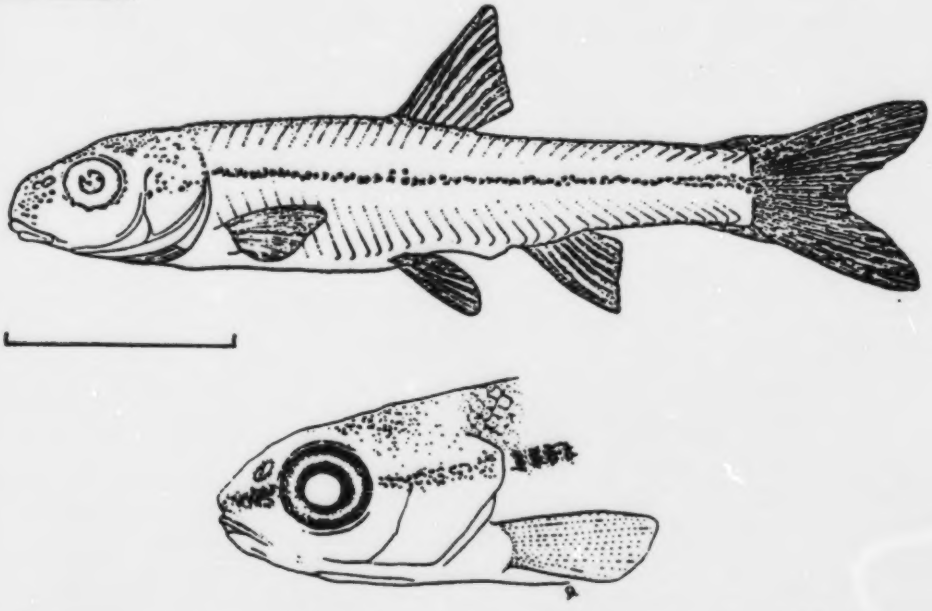

Fig. 6. Lateral view of *Notropis heterolepis* at 20 mm TL collected in eastern Lake Erie (Fish (1932), and lateral aspect of head at 25 mm TL. Length bar = 5 mm.

A continuous lateral stripe on the snout, operculum, and horizontal myoseptum dominates pigmentation on 14-18-mm fish. The head has a dark patch on the occiput, and the dorsal surface of the body is covered with punctate melanophores. The ventral surface of head and gut are usually barren. The edge of each scale on the dorsum peduncle is darkly pigmented at 20-25 mm, and the surface of the body is darker than on smaller fish. Pigmentation on the snout is similar to

that on adult fish (Fig. 6). All rays of fins are very lightly pigmented and a faint basicaudal spot exists.

DISCUSSION

Age 0 blackchin shiners and blacknose shiners closely resemble each other morphologically at all early stages of development, but especially as newly hatched larvae. As such, they are probably impossible to separate should they co-occur. However, because each requires a particular ecological niche for reproduction and nursery, fishes are usually separated spatially, if not temporally. The blackchin shiner, a phytophil, is an obligate plant spawner in rather static conditions, whereas the blacknose shiner, a psammophil, spawns in moving water over sand or roots. Several field surveys tend to confirm environmental separation of the species. For example, blacknose shiners do not occur in densely vegetated Hog Bay, where blackchin shiners are abundant throughout ontogeny. In Penetang Harbour, blackchin shiners are found among submersed vegetation, and blacknose shiners among emergent plants (Leslie and Timmins 1997a). Similarly, the numerical dominance of blacknose shiners is a feature of the taxocene in Long Pond, Long Point, where blackchin shiners are not found at any life stage (Mahon and Balon 1977). Although Leslie and Timmins (1997b) found age 0 stages of both species in Long Point inner bay, they inhabited different ecotones. Finally, adults of both species were collected near shore in the Detroit River, but not on the same sampling date or in the same type of habitat (Leslie and Timmins 1999).

Undoubtedly, features that effectively differentiate age 0 blackchin shiners and blacknose shiners >12-14 mm TL are those of form and shape of the head (Fig. 3; Fig. 6). The snout is pointed and the chin pigmented in blackchin shiners; these respective characters are rounded and clear in the blacknose shiner. Whereas the maxilla extends below the centre of the nare in the blacknose shiner, it is located at the posterior margin of the nare in the blackchin shiner. Finally, the tip of the upper jaw and the upper half of the eye are in line on the blackchin shiner; on the blacknose shiner, the tip is in line with the lower half of the eye.

Various age 0 cyprinids may be identified according to size if spawning and hatching dates are staggered, provided sufficient descriptive information is available. Recently hatched blackchin and blacknose shiners may be separated from other cyprinids on the basis of myomere

counts, pigmentation, and occurrence of developmental events. Of two fishes with "outlined" gut pigmentation (Fuiman et al. 1983) and one with central pigmentation on the gut, only the bluntnose minnow *Pimephales notatus*, a speleophil, has myomere counts that overlap those of blackchin and blacknose shiners. However, both the blackchin shiner and the blacknose shiner have one less modal preanal and one more postanal myomere than bluntnose minnows. Unlike blackchin shiners, bluntnose minnows are devoid of melanophores on the snout until 8-mm TL, and are barren on the chin. Further, bluntnose minnows develop an inferior mouth and distinct caudal spot at 7-8 mm (Buynak and Mohr 1979). These features are not present at any stage in the blackchin shiner, whilst blacknose shiners develop an inferior mouth at about 14 mm and the caudal spot is weakly defined. Moreover, the bluntnose minnow has 7 anal fin rays, one fewer than shiners.

Because many cyprinids resemble each other, their identification is always problematic. Further studies are needed to corroborate our descriptions, to expand knowledge of reproduction and ecological requirements, and to describe egg and embryo development.

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